A Geometrical Optics Model for Interferometric Synthetic Aperture Radar Height Measurements for Urban Areas

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In this talk a Geometrical Optics (GO) scattering model is presented for interferometric Synthetic Aperture Radar (InSar) height measurement of Urban areas which are charaterized by man-made objects. SAR measurements from Urban areas are dominated by multiple scattering and layover effects which are different from natural terrain. Two and three dimensional scattering models are considered to simulate the IntSar measurements. The model is based on the geometrical optics including edge diffraction and material effects. A forward ray tracing algorithm is used to provide efficient computation of multiple paths for arbitrary geometrical arrangements. For a two dimensional height profile, the backscatterd field is compued by launching a dense set of rays towards the geometry. The rays contributing to the backscatterd fields are collected on an aperture plane, and their contributions to an observation point are computed according to the transmitted signal pulse length. Each contributing ray is associated with a ray foot print and a linear phase taper indicating the direction of propagation with respect to the normal vector to the aperture plane. Scattering from three dimensional profiles are computed by a facet based high frequency electromagnetic-scattering prediction method (D.J. Andersh, M. Hazlett, S.W. Lee, D.D. Reeves, D.P. Sullivan and Y. Chu, IEEE Trans. Antennas propgat. Mag., vol. 36, pp.65-69, Feb. 1994). An estimate of the height profile is derived for the backscattered field measurements from two receivers displaced in the range direction by a baseline length (E. Rodriguez, and J.M. Martin, IEE Proceedings-F, Vol. 139, No. 2, April 1992). The relative phase difference between the receivers is used to locate the position of the dominant scattering center. It is of interest to characterize the multiple scattering and shadowing effects in the derived height profile. Multiple scattering, in general, displaces the scattering center position due to the increase in the effective path lenght of a contributing ray. For a corner reflector geometery, the path lengths for all the contributing rays are equal to the path lenght corresponding the origin of the corner reflector. In the case of scattering from a number of structures, the position of the scattering center is displaced further away from the actual scattering location with respect to the transmitting source. In this presentation a number of geometrical configurations which produce single and multiple scattering, layover , and shadowing effects are considered. The derived height accuracy as a function of radar parameters, angle of incidence, and the height profile will be discecused. The simulated results will be compared with the InSar measurements over a selected number of urban areas.